

(30. X. 2011)

---

**JOINT MEETING:  
CBS EXPERT TEAM ON AIRCRAFT BASED  
OBSERVATIONS  
(Third Session)  
AND  
AMDAR PANEL  
(Fourteenth Session)**

ITEM: 3.3

Original: ENGLISH ONLY

(QUEBEC CITY, CANADA, 2-4 NOVEMBER 2011)

### **AMDAR Program Status**

#### **Report on Activities by the Science and Technical Sub Group**

*(Submitted by the Chairman of Science and Technical Sub-Group)*

---

#### **Summary and purpose of document**

The addressed activities are concerned with investigations about the quality features of AMDAR observations and their impact on the numerical weather prediction.

---

#### **ACTION PROPOSED**

The Joint Meeting is invited to note the information contained in the document.

#### **References:**

1. Gelaro et al., 2010: The THORPEX Observation Impact Intercomparison Experiment. Mon. Wea. Rev., 138, 4009 – 4025
  2. Ballish, 2011: Analysis of Select Upper Observations Stats in the North American Area, NCEP Presentation of 21 Sept. 2011
  3. Drüe, Clemens, 2011: Reconstruction of Aircraft Trajectories from AMDAR Weather Reports. J. Atmos. Oceanic Technol., 28, 921–932
  4. Lemaitre, IAGOS-Contribution to 18<sup>th</sup> EUMETNET AMDAR Technical Advisory Group Meeting, Oct. 2011
-

### **The THORPEX Observation Impact Intercomparison Experiment**

An experiment is being conducted to directly compare the impact of all assimilated observations on shortrange forecast errors in different forecast systems using an adjoint-based technique. The technique allows detailed comparison of observation impacts in terms of data type, location, satellite sounding channel, or other relevant attributes. This paper describes results for a “baseline” set of observations assimilated by three forecast systems for the month of January 2007. Despite differences in the assimilation algorithms and forecast models, the impacts of the major observation types are similar in each forecast system in a global sense. However, regional details and other aspects of the results can differ substantially. Large forecast error reductions are provided by satellite radiances, geostationary satellite winds, radiosondes, and commercial aircraft. Other observation types provide smaller impacts individually, but their combined impact is significant. Only a small majority of the total number of observations assimilated actually improves the forecast, and most of the improvement comes from a large number of observations that have relatively small individual impacts. Accounting for this behavior may be especially important when considering strategies for deploying adaptive (or “targeted”) components of the observing system.

(Gelaro et al., 2010)

### **Reconstruction of Aircraft Trajectories from AMDAR Weather Reports**

It is well known that aircraft-based meteorological measurements exhibit systematic errors depending on various flight dynamic parameters. It is also widely assumed that operational Aircraft Meteorological Data Relay (AMDAR) weather reports by commercial aircraft are affected in a similar way. However, so far, it is not possible to study such systematic errors, because datasets that contain both AMDAR reports and flight dynamic variables are not available. To overcome this deficiency, a method was developed to reconstruct the flight trajectories of aircraft using just the aircraft type and operational AMDAR reports. Because AMDAR reports do not contain information on the flight plan, origin, destination, or the motion vector of the airplane, it is not possible to employ a trajectory solver as used by air traffic control. Instead, the method uses groups of trajectory templates that are fitted to AMDAR data taken during approach or departure. This algorithm allows estimation of the heading, true airspeed, aircraft mass, roll state, pitch angle, and angle of attack of the reporting aircraft for each AMDAR report. For verification, the algorithm was applied to navigation data gathered from two Airbus-manufactured aircraft, of which one is in commercial service and one is used for aviation research. From a total of 48 profiles, a very good agreement of reconstructed and measured values was found.

The availability of the parameters true airspeed and true heading yields a potential for quality control of the wind data.

(Drüe, 2011)

### **NCEP Analysis of Select Upper Observations Stats in the North American Area**

There are considerable temperature bias differences in the North American area and bias corrections are needed. The aircraft moisture data have larger counts and better stats than sondes. The Canadian AMDAR data have moderate warm biases, good wind stats, counts higher than sondes. Both are not used in the GFS. The VAD winds have large counts and poor stats but are used in the GFS. Further work is needed to show stats for different aircraft phases of flight, aircraft types or by airlines as well as stats comparing the observations and analyses.

(Ballish, Sept. 2011)

## **IAGOS (In-service Aircraft for a Global Observing System)**

The IAGOS infrastructure is now at the end of the third year of its preparatory phase and it had its annual Meeting at the University of Manchester, UK, last September.

Among the highlights of this past year, the operation of the first IAGOS equipped aircraft, on July 8 at Deutsche Lufthansa was a relevant milestone as it provided the certification of the European Aeronautical Safety Agency (EASA) to the Airbus A-340 aircraft equipped with the new IAGOS instrumentation. This opens the perspective for new IAGOS aircraft of companies Air France and Iberia. Other certifications are currently underway for the A-330 aircraft and at other aeronautical safety agencies (Taiwan, United States). Researchers in the United States have created a working group "IAGOS in the USA" to improve understanding of the impacts of trace gases and Particulate Matter on air quality and climate change. The aim is to vastly increase their measurement capabilities through the installation of IAGOS equipment on U.S.-based commercial aircraft.

After past volcanic ash events over Europe, IAGOS took a leading role in the preparation of the "WMO/IAGOS Technical Experts Workshop on Requirements for In-Service Aircraft Aerosol Measurement Systems", in Geneva, March 2011. Its key objectives are to establish a link between aerosol dose on aircraft and engines and their maintenance requirements as well as to improve the unambiguous detection of volcanic ash and mineral dust particles by simple and robust instruments suitable for on-board instrumentation of civil aircraft.

Among the regular activities of the infrastructure preparatory phase, real-time data transmission has also progressed at Météo-France with the development of a RTTU (Real-Time Transmission Unit) prototype at the company ATMOSPHERE. Functional tests should be performed in early 2012 from the first IAGOS equipped aircraft of DLH to the E-ADAS (E-AMDAR Data Acquisition System). A cooperation with IAGOS was agreed by EUMETNET at its general assembly of May 2011. It allows the use of E-ADAS as a reception facility for the real-time IAGOS reports and their emission over the WMO Global Telecommunication System. The effective transmission of IAGOS reports to real-time users at air quality and weather prediction centres will however not take place before 2014, after installation and aeronautical certification of the RTTU equipment. Certifications of additional IAGOS instruments for the measurement of Greenhouses Gases and aerosols will be completed in the last year of the IAGOS project, in 2012.

(Lemaitre, 2011)

## **Icing**

From Gilles Fournier, Canada:

General comment:

No input was received from STSG members and other contacts probably indicating little progress on this issue over the year.

### **1. Summary of Issue and Progress with Reference to Actions:**

- The STSG to analyse the USA experience with reporting of icing associated with the TAMDAR GLFE: Pending.
- The most appropriate elements and methods for automatically reporting conditions for ice accretion from aircraft: No known progress.
- Appropriate methods and systems for the operational use of ice conditions including assimilation into NWP: No known progress on the methods and systems. However in their national status

report the USA have reported on the progress and plan for the development of their Forecast Icing Product (FIP) Severity and Current Icing Product (CIP). Also in Canada the Canadian Meteorological Centre (CMC) is producing some new icing products based on high resolution model data but these are not currently verified. A Canadian paper entitled 'Decision Making Regarding Aircraft De-Icing and In-Flight Icing Using the Canadian Airport Nowcasting System (CAN-Now)' presented at SAE 2011 International Conference on Aircraft and Engine Icing and Ground Deicing, 13-17 June 2011, Chicago, is attached but the system does not yet use any AMDAR data.

- The operational impact of icing data: No known progress.

## 2. Suggested Actions for 2011/2012

- If STSG is not in measure to direct the work for the development related to icing it must at least continue to monitor the development as it regards: the elements and methods for automatically reporting conditions for ice accretion from aircraft; the methods and systems for the operational use of ice conditions; and the impact of icing data.
- The Panel to investigate the viability of utilising a water vapour sensor and the data derived as a means for detecting and warning of the potential for icing, particularly for supercooled large droplets (SLD). Is there potential to use this as a benefit for airlines implementing WVSS?

## Impact Studies

From Gilles Fournier, Canada:

General comment:

No input was received from STSG members and other contacts probably indicating little progress on this issue over the year.

## 1. Summary of Issue and Progress with Reference to Actions:

- The STSG to continue to monitor and review publications and activities associated with AMDAR data impact studies: This is an on-going activity. A presentation entitled 'Impact of aircraft data in the MSC forecast systems' by Stéphane Laroche and Réal Sarrazin of Environment Canada was presented at the recent Canadian AMDAR Strategy Workshop that took place in Toronto on 20 October 2011 is attached. They are results from a previous OSE study already presented to STSG but packaged in a format that emphasizes the value of AMDAR.

## 2. Suggested Actions for 2011/2012

- STSG to continue to monitor and review publications and activities associated with AMDAR data impact studies as this is an on-going activity. In particular a milestone will be the Fifth WMO Workshop on the Impact of Various Observing Systems on NWP, Sedona, AZ, United States, 22 to 25 May 2012. Members of STSG participating should be encouraged to report back to STSG especially when studies involve AMDAR data.
-